CLINICAL, RADIOLOGICAL AND RHINOMANOMETRICAL DIFFERENCES BETWEEN ANTERIOR AND POSTERIOR DNS ASSOCIATED WITH LATERAL WALL PATHOLOGY

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Dedicated to all my teachers of Past & Present

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CERTIFICATE

This is to certify that the work entitled **"Clinical, Radiological and Rhinomanometrical differences between anterior and posterior DNS associated with lateral wall pathology"** which is being submitted for MS (ENT) examination 2006 of Bundelkhand University, Jhansi, has been carried out by **Dr. Inderjeet Singh** personally in the department of E.N.T., M. L. B Medical College, Jhansi, under my guidance and supervision. The observations were checked by me periodically.

He has put in necessary stay in the department as per university regulations.

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Date: 13/10/2005

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Introduction

INTRODUCTION

Nasal obstruction is a symptom not a disease and there are plethoras of conditions that can cause such symptoms. One of the commonest causes of nasal obstruction is deviated nasal septum.

The usual cause of nasal obstruction is insufficient passage of air through the nasal valves.

The valves can be briefly defined as:

1) Lower lateral cartilage, Columella, Nasal floor which comprise **External nasal valve.**

2) Caudal end of Upper lateral cartilage, Nasal septum, soft tissue surrounding pyriform aperture form the **Internal valve.**

3) Perpendicular plate of Ethmoid, Quadrangular cartilage and Vomer form the **Septal valve.**

4) Anterior end of Inferior turbinate also acts as a valve.

As the nasal septum, in some way or other plays a role in the formation of these valves any deformity in the septum can cause nasal or associated symptoms.

A straight septum is not a common fmding. It has been estimated that as many as 75% to 80% individuals have some type of deformity of nose. Trauma and birth molding are considered to be important factors in causation of DNS, other factors may be racial (more common in Caucasians) and hereditary factors.

Septal deviation is divided into anterior and posterior type on the basis of its location as in front or beyond the pyriform aperture.

Septal deviations anteriorly in the region of nasal valve area cause the greatest obstruction, because this is the narrowest part of the nasal cavity. Posterior deviation usually causes neurogenic headache or middle ear infection. Other features like sinusitis, epistaxis, anosmia, PND etc, can be caused by anterior and posterior DNS both. Small septal deviation in the anterior part of the nose can cause significant obstruction whereas large deviation can be present in the cavum without affecting airflow resistance.

Septum cannot be considered in isolation without inspecting lateral nasal wall. A compensatory hypertrophy of the turbinates, enlargement of ethmoidal bulla, polyposis, maxillary sinusitis, pansinusitis and associated osteomeatal complex disease can occur on the same side as the opposite side of septal deviation. Plain X-ray can be helpful in assessing

posterior bony deviations but are not useful in assessing anterior cartilagenous deviations. Some conventional radiographs are :-

a) Caldwell projection

b) Lateral projection

c) Water projection

d) Submentovertex projection

These radiographic films are adequate only for preliminary assessment of the praranasal sinuses. The anterior ethmoidal sinuses, upper nasal cavity and frontal recess are poorly demonstrated in these views. In many patients with significant osteomeatal complex disease, detailed examination of their conventional radiographs may reveal no abnormality.

Nasal obstruction is probably the most often encountered chronic complaint in rhinological practice. The clinician is frequently confronted with the issue whether the septal deviation encountered during examination is responsible for the patient's obstructive symptom. In many cases the answer is not so straight forward as it may appear.

An extremely deviated septum that completely obstructs the nasal passage undoubtly requires surgery however with less pronounced

deformities, which are more frequent the surgeon is left with; their subjective assessment of degree of obstruction to make therapeutic decisions that ultimately involves surgery.

The importance of a thorough preoperative evaluation has been stressed, because other causes of nasal obstruction (e.g. chronic rhino sinusitis, polyp etc) are frequently concomitant, and tend to be overlooked when the surgeon's attention is immediately drawn to an obviously deviated septum. However few objective tests seemed to have helped clinicians in the past.

CT scanning of the paranasal sinuses are indicated whenever surgery is planned or sinus complication are suspected along with DNS. No other imaging modality provides so much information as the CT scan. It provides better bony details. It helps to delineate subtle pathology, extent of pathology depth of invasion and anatomy of structure pre-operatively. Sinus screening CT is done in all clinically diagnosed cases of rhinosinusitis not responding to medical treatment, recurrent acute and chronic sinusitis. The CT cuts are done in limited numbers at 5-10 mm gap to identify the area of interest. After identifying the area of pathology more CT images are taken at that level for obtaining detailed information.

There are five basic CT pattern in cases of sinu-nasal inflammatory diseases which are as follows :-

Coronal scans are preferred because the anatomy and pathology are examined in a plane almost identical to that approached by the endoscopist. If there is doubt about its adequacy for a complete examinations scans in the axial plane are also done.

Rhinomanometry is an objective test for quantitative estimation of nasal patency.

Rhinomanometery after decongestion of nose is obviously useful for selecting patients in whom surgery can be expected to be beneficial in terms of improvement in nasal patency. For instance a deviation in the region of valve may cause obstructive symptoms whereas a much more severe spur posteriorly might cause headache and other symptoms rather than obstruction. Thus the patients having anterior DNS are better suited to undergo surgery for nasal obstruction e.g. septorhinoplasty and a patient with posterior spur is benefited for endoscopic spurectomy without touching the other parts of septum. These kinds of dilemmas on the part of surgeon can very well be removed by rhinomanometery.

Rhinomanometery measures the nasal patency utilizing the physics of airflow. Air will only flow through a tube when there is a pressure

difference between the two ends. In rhinometery we continuously measure the pressure external to the nose and in retronasal space: the pressure difference (ΔP); simultaneously we monitor the flow rate (V) of air. Because the length of the nasal cavity is constant, change in diameter or patency have major influences.

Rhinomanometery is also named as; rhinoreometery, rhinometery; rhinography etc. Rhinomanometery can be active or passive. The commonly used method i.e. active rhinomanometery can be subdivided into anterior and posterior rhinomanometery, out of which anterior is the preferred choice as it is easy to perform and gives better results. Passive rhinomanometery is particularly helpful if it is required to separate between upper and lower airway for experimental works. Other methods to measure upper airway patency are Plethysmography, Peak expiratory flow rate, Rhinohygrometery, Nasometery, Oscillometery, Echomanometery, Rhinostereometery, and last but not the least Acoustic rhinometery.

Apart from clinical evaluation of nasal obstruction, rhinomanometery can help to assess the patients of sleep apnea syndrome, allergy challenge test, nasopharyngeal patency, velvopharyngeal functions, investigation of functional nasal problems, medico legal assessment.

Functional nasal airway measurement is important in the understanding of nasal physiology, and is a useful diagnostic tool in patients with nasal disorders. The sensation of nasal obstruction, nasal resistance and minimal cross-sectional area are three distinct parameters of nasal patency that are more or less related to each other. A combination of these techniques represents the state of the art for a functional and quantitative study of the nasal airway.

Aims & Objectives

AIMS AND OBJECTIVES

{1} To evaluate the clinical radiological and rhinomanometrical differences in the anterior and posterior DNS.

{2} To find out the relative occurrence of anterior and posterior DNS in Bundelkhand region.

{3} To find out the effect of DNS (anterior and posterior) on the same side and opposite side lateral wall structure.

{4} To evaluate post operatively the extent of improvement in symptoms and pathological changes that have occurred in the nasal cavity after surgery.

Review of Literature

REVIEW OF LITERATURE

Nasal obstruction is a common clinical symptom among patient referred to ENT department. According to ***Won Graf et al (1987)***, this is the main symptom in 15% of the patients visiting a British ENT outpatient clinic. In a Finish study by ***Vainio-Mattila (1974)*** of the 200 renderly chosen adults, 33% had a nasal breathing problem on a regular or frequent basis. Causes of nasal stuffiness are many with allergic & vasomotor rhinitis and polyps being the most important structural cause. In ***Vainio-Mattila's, 1974*** study, 26% of examined patients had septal deformity which was considered clinically significant.

Etiology: ***Gray (1972)*** explains these cases by means of birth moldings theory; abnormal intrauterine posture may result in compression forces acting on the nose and upper jaw. However in a recent extensive study carried out in ***Birminigham (Kent et al: 1988)***, found that the type of delivery, the presentation, the parity, the birth weight and the gestation period did not have any significance. This is in agreement with the findings of ***Jaztri (1974), Pease (1968) and Hartikanon-Sorri et al (1983)***.

In 1875, ***Sir Francis Galton*** advocated in the study of identical twins as a mean of differentiating between deformities caused by genetic and environmental factors.

Such a study was recently carried out by ***Grymer and Melson (1989)*** which were able to examine 41 pairs of identical twins. They found that 21% of these individuals had an anterior septal deviation and that same type of deformity was present in posterior part of septum in 74%. The distribution of the deviation within the twins suggested that anterior lesions were due to an external cause (trauma), whereas the posterior lesions were due to genetic factor.

The incidence of the neonatal septal deviations is about 4% ***(Kent et al 1988)*** although these lesions may be due to both trauma and genetic factors. Recent research tends to suggest that role of trauma is less important then that was once believed.

Hinderer (1971) stated that there are three distinct periods in development of relative quiescence and last five years of acceleration in the growth. Injuries during these periods are likely to cause long term deformities. ***Fry (1973)*** applied the principle of cartilaginous infrastructures developed by ***Gibson and Davis (1967)*** to explain these clinical observations.

The effects of septal deviations are nasal obtruction, mucosal changes; neurological chages etc. Septal deviations in the region of the basal valve area cause the greatest obstruction, because this is the narrowest part of nasal cavity.

As far as history of septoplasty is considered ***Freer (1902)*** successfully performed submucosal resection of total septal cartilage. ***Killian (1904)*** devised 'Modified Freer method' preservation of dorsal and caudal portion of septal cartilage. ***Mezebaum (1929)*** did Septoplasty by 'Swinging door' technique ***Peer (1937)*** forwarded concept of removal of caudal septum and replacement after its alteration ***Cottle (1958)*** gave the concept of 'Maxilla-Premaxilla' approach

In the recent experimental study by ***Cole et al (1998)***; "effects of simulated deviations on nasal airflow resistance" it was found that small septal deviations in the anterior part of nose can cause significant obstructions, whereas large deviations can be present in the cavum without affecting airflow resistance.

Roman Chaban, Philip Cole (1987) in their recent study "simulated septal deviations" found that the maximum resistance to nasal airflow was encountered at the valvular area. Similar were the findings of

Sami, Elwary, Hossan Thabet in their study published in JLO march 1996.

The term nasal valve owes its origin to Mirk and it is defined as the slit like cleft between the caudal end of the upper lateral cartilage and the septum. The upper lateral cartilage is the mobile limb of the valve ***(Haight, 1983; Kasper, Bare and Kem, 1887)***.

Dishocck (1965) and ***Bridger and Proctor (1970)*** localized the valve at the junction of the upper and lower lateral cartilage. The nasal valve is the most flexible and the narrowest part of the nasal airway. Physiologically the nasal valve offers the greatest resistance to nasal airflow, and generally it functions as an inflow device controlling airflow and resistance ***(William, 1972; Ogma, 1977; Viani and Jone; 1990)***. Inspite of this fact little attention has being given to contribution of nasal valve abnormalities to the problem of chronic nasal obstruction in adults. ***Prez 1975*** and ***Perry, 1981*** found that nasal valve obstruction commonly occurs following corrective rhinoplasty especially after resection of upper lateral cartilage, following hump removal and infrastructure of nasal bone. ***Robinson and Buzet, 1990*** reported nasal valve dysfunction after resection of nasal cancers. Also ***Sulsenti and Palma, 1989*** found that

obstruction of nasal valve is frequently induced/aggravated by previous rhinological surgery.

The respiratory and olfactory functions of the nose were clearly recognized in ancient Egypt. The importance of a patent airway is clearly acknowledged in the following aphorism:

'Alive and healthy is he who is breathing through his nose'

one ancient rhinologist stated:

'He from whose nose breathing is robbed must die'

Surely many contemporary suffers of nasal obstruction would agree from this statement. According to Hippocrates 'free respiration is to be looked upon as contribution much to the safety of the patient. Aristotle however thought that the main function of the nose was sneezing; he further recognized that the nose can be bypassed and lung could be aerated without the process of respiration. Although ***Galen*** understood respiratory functions of the nose but none of his works mentioned respiratory obstruction.

Further medical interest in nose had to wait the Renaissance and it's scientific off springs; however the functional aspects of nasal

physiology were poorly understood until 19th century. A clear concept of physiological basis of nasal obstruction had to wait the 20th century.

The nasal physiologic functions, such as warming and humidification, are vital for upper airway function. It has been estimated that an adult inspires up to 10,000 liters of air daily *(Kerr, 1997)*. Filtration of environmental particles occurs first in the nasal cavity. The largest particles are filtered by vibrissae. In adults, nasal resistance can contribute up to half of total airway resistance *(Kerr, 1997)*. Through heat exchange, the nasal mucosa maintains the nasal cavity at a range of 31-37° Celsius *(Kerr, 1997)*.

One theory regarding the efficiency of heat exchange relates to the location of the sphenopalatine artery. The sphenopalatine artery courses anteriorly in the nasal cavity over the turbinates, whereas air flows in a posterior direction forming a countercurrent exchange *(Kerr, 1997)*. Thus, the 2 opposing motions create a more efficient heat exchange process. However this process remains imperfect, and as much as 10% of heat loss occurs in the nose.

Nasal airway resistance accounts for more than 50% of total airway resistance *(Bailey, 1998)*. The nasal cavity has been modeled as 2

resistors in parallel ***(Kerr, 1997; Cummings, 1999)***. The nasal vestibule, nasal valve, and nasal cavum ***(Bailey, 1998)***.

The term nasal valve most often refers to the internal valve, which is the limiting region of airflow. The nasal valve is defined as the lower edge of upper lateral cartilages incorporating the anterior ends of the inferior turbinates adjacent to the nasal septum and the upper lateral cartilage is 10-15° ***(Myers, 1993)***. The nasal valve usually is located less than 2 cm distal in the nasal passageway, approximately 1.3 cm from the naris. The average cross-sectional area is 0.73 cm^2 ***(Bailey, 1998)***. Nasal resistance is composed of 2 structural elements; the first layer is composed of underlying bone, cartilage, and muscle, and the second layer is the overlying mucosa.

As many as 10% of patients have been identified with nasal obstruction following rhinoplasty ***(Beekhuis, 1976)***. Nasal valve contraction may be due to improper placement of intercartilaginous incisions ***(Beekhuis, 1976)***. The Cottle test may be used in the office for the diagnosis of nasal valve obstruction. A positive Cottle test result (improvement of subjective nasal airflow with lateral displacement of the cheek and alae) may suggest collapse of the valve after rhinoplasty. Parkes writes that inaccurate trimming of the upper lateral cartilage can

cause protrusion of the cartilage into the nasal airway causing nasal obstruction ***(Parkes, 1980)***.

A successful rhinoplasty is both aesthetically and functionally sound. The success of a postoperative external nose is diminished when the patients is unable to breathe through his or her nose. A narrowed supratip area due to over resection of the upper lateral cartilages may cause significant nasal obstruction ***(Sachs, 1989)***. The periosteum of the bony nasal vault serves to hold the nasal bones in place after osteotomy. Sachs states that it is crucial for elevation of the periosteum to be exact. Periosteal elevation should begin 2 mm above the caudal edge of the nasal bones and proceed laterally to the extent that is half the distance of the width of the remaining nasal bones after hump removal.

Osteotonies may be the most destructive portion of the rhinoplasty, and so carefully planning is crucial. One approach first focuses on the glabellar area. ***Sachs*** believes that most glabellar regions do not need narrowing and thus osteotomies do not have to be carried to their most superior extent in the nasal-frontal suture line. Sachs also states that periosteal elevation should be minimized. Insertion of the osteotome is also important to prevent the formation of scarring of the anterior vestibule; a nasal speculum should be used to retract the nasal vestibule

as laterally as possible insertion of the osteotome along the pyriform aperture.

The nasal valve is an important consideration in rhinoplasty. In particular, 2 incisions have great potential to change the dynamics of the valve. The intercartilaginous incision and the disarticulation of the upper lateral cartilage from the septum have the potential to increase nasal resistance. The caudal aspect of the upper lateral cartilage should not be excessively trimmed. The nasal valve functions by moving into the vestibule as airway resistance increases. This movement is hampered when insufficient mucosa remains for coverage of the caudal aspect of the upper lateral cartilages *(Sachs, 1989)*. During alteration of the lower lateral cartilages, care should be taken not to resect too much of the most caudal aspect of the cartilage *(Sachs, 1989)*. Over resection in this area leads to alar collapse and nasal obstruction.

Consistent with maintaining lower lateral cartilage support, the nasal tip may be modified by trimming the cephalic borders of the cartilage and inserting tip grafts superficial to the cartilage or by rotating the domes by lateral trimming of tip cartilages *(Sachs, 1989)*. Sachs states that, during rotation of the dome by lateral trimming of tip cartilage, internal vestibular skin must also by trimmed appropriately to avoid airflow obstruction. The feet of the medial crura are additional

factors. Sachs states that protrusion of the medial crura into the nasal airway may contribute to obstruction *(Sachs, 1989)*. Beekhuis discusses a number of potential causes of nasal obstruction due to the nasal septum. It is noteworthy that asymptomatic septal deviations may become problematic for the patient after rhinoplasty, *(Sachs, 1989)*.

Sachs (1989) also writes that an important area of the septum to consider is the upper bony septum in the area of the perpendicular plate of the ethmoid. Sachs states that this area may cause nasal obstruction and prevent inward displacement of the nasal bones during osteotomy. Correction of the inferior portion of the septum is also important. Rhinoplasty that includes alar base resection moves the sides of the nose medially, and the turbinates can be in contact with previous septal deflections.

Hypertrophic turbinates may also contribute to nasal obstruction after rhinoplasty; resection of the inferior turbinate may be necessary. Septal deformities that affect the nasal valve and narrow the angle between the septum and upper lateral cartilage may cause obstruction. Papal states that separation of the upper lateral cartilage and septum during rhinoplasty may cause a depression of the upper lateral cartilages and increase obstruction at the internal nasal valve *(Myers, 1993)*. *Tardy (1997)* states that the upper lateral cartilages (unless deformed or

asymmetric)should be left attached to the septum in the vast majority of patients and that damage to the internal valve commonly results from separating the upper lateral cartilages from the septum. ***Papal*** states that incision must also be well placed to avoid scarring across the nasal valve area causing obstruction ***(Myers, 1993)***.

In conclusion the ability to alter the physical structure of the nose has notable potential for changing a patient's nasal airflow. Care must be taken to consider the dynamics of the nasal airway and preserve its function.

In ***1985, Kayser*** described the nasal cycle. This was confirmed by ***Heetende in 1927*** and was studied rhinomanometerically in ***1953 by Stoksted***, who demonstrated that total nasal resistance remained constant despite changing volume of blood in the tissue of each nasal cavity. The cycle is usually of 3 to 4 hours, although it can be of as little as 30 minutes. It is disturbed by posture, exercise and pressure on one side of body, such as on lying on one side of body. Asymmetric pressure on skin when upright can also lead to increase in resistance. The axilla is the most sensitive area to provoke this reflex, a fact known to exponents of yoga who realized some centuries ago that leaning on a crutch in axilla altered blood flow in nose.

There are very few publications on CT reporting related to functional endoscopic sinus surgery. Majority of surgeons prefer to review CT images personally though reported by radiologist before taking decision to select the approach and extent of the procedure.

Jiannetho & Pratt (1995) conducted a five years CT study on 84 patients with maxillary and ethmoid disease. The preoperative evaluation was done independently by radiologist and surgeon himself. The operative findings compared more closely with the surgeons than the radiologist.

Jorgeman RA (1991) prepared the first comprehensive CT reporting format using computer graphics for documentation. His creation of format was based on the assumption that information presented usually is rapidly assimilated. He tried to incorporate diagrams of CT images in all planes (coronal axial and saggital) depicting related areas and structures.

Advantages

It carries following advantages.

1. Helps in treatment planning
2. Helps in deciding extent of surgery

3. Helps in maintaining data

4. Helps in resident training

5. Helps in communication of information

6. May help in staging sinus disease

7. Helps in easy recording of finding.

Limitations

It also carries following limitations.

1. It is not a substitute for CT images in the operation theatre

2. It does not provide finer details.

Stoney et al (1992)

Stoney et al (1992) appreciated significant contributions made by Jorgensen's chart but at the same time pointed out some areas of disagreement. They are as follows :

1. They are of the opinion that the visual-impact would have been more if visuals were not available. But the CT visuals are available on hard disc.

2. The term used for describing the pathological detail was not defined in their text.

They came out with a systematized reporting frame work which they claimed can be adopted by all and also ideal for its incorporation into a computerized system of written report generation. They also took pains to define the terms used in basic set of descriptions in view of the varied definitions employed in different centers. They also claimed that their reporting system provides very detailed picture of the radiological status of the sinuses.

They suggested the following things for bringing improvement in the CT reporting.

1. The preoperative CT images should preferably be evaluated together by surgeon and radiologist.
2. CT films should be available in the operation theatre for verification if need arises.

They observed some differences in mucosal changes and anatomical abnormalities between the reports using reporting scheme and without it. They concluded that use of reporting system is useful and more informative.

Elahi et al (1998)

In their opinion the formats could not be standardized as a result of inadequacies in the reporting system. They also attempted to develop a

simple format for reporting sinus CT images.

They laid special emphasis that the report should provide meaningful information to help surgeon in taking decision and carrying out safe and curative surgery.

They took this exercise to consolidate and enhance the complimentary relationship between the preoperative imaging and endoscopy. They sub-categorized the reporting proforma into fifteen spanning the vast majority of structural and pathologic abnormalities with in the sinu-nasal region.

They agreed with the effectiveness of visual presentation of CT imaging information claimed by ***Jorgensen (1991)***, and preferred to include diagrams in the format rather than drawing at the time of reporting for the following reasons :

1. It will be cumbersome
2. It will be time consuming
3. It may be of questionable significance
4. It will bring uniformity.

They also pointed out the inherent dependency on computer access, although readily available (developed by ***Stoney et al, 1993***). It invariably

limits its portability for the format. They labelled the list of areas as exhaustive which may not be approved by our radiology colleagues and hence questioned the implications of such a complicated model in routine clinical practice.

They observed the following precautions while developing the CT reporting format.

1. Simple and concise
2. Utilization in every day practice
3. Allow for expediency in completing data entry
4. Avoid use of complicated terminology
5. Provide meaningful report.

They did confess that their format did not allow a radiologist to include certain degree of descriptive autonomy. They have to interpret CT films only according to item presented in the format. They claimed effective control on time to complete the report.

Like any other system the use of format in CT reporting will have some advantages and few limitations, but gradually, it is likely to produce a perfect system of reporting.

For over 100 years, interest been shown in evaluation of nasal

airway. This is undoubtly in response to the fact nasal obstruction is a common out patient problem. However, development of reliable methods of objective assessment has been slow, and despite many different approaches, majority of the practitioners still relying on patient's history and simple rhinoscopy. It is worth considering those factors responsible for change in nasal airway and the possible uses of objective assessment.

In the past there have been scientists who have devised various tests to assess nasal airway. At the turn of century ***Fox et al, 1971***; ***Hilberg et al***, used methods such as breathing on a mirror, assessing sound of forced expiration, evaluation of the pitch of sound etc. The readily available expiratory flow meter has been used to measure the nasal resistance *(Taylor et al, 1973)*.

Rhinomanometery is a relatively new technique. ***Fox et al, 1971***, and ***Kaysoy 1979*** have presented a history and development of rhinomanometery. From historical point of view rhinomanometery is of two types anterior and posterior. Posterior rhinomanometery was introduced by ***Spiess in 1899*** and anterior by ***Contade in 1902***.

Rhinomanometery is defined by the American academy of Ophthalmology and Otolaryngology (***Rochester, Minnesota; 1970***). Rhinomanometry now is well established as a useful clinical method for

objective assessment of nasal patency. Nasal resistance to airflow is calculated from measurements of nasal airflow and transnasal pressure. In 1983, standardization of Rhinomanometry was established and accepted worldwide. The nasal resistance is calculated from the measurement of the nasal airflow at a fixed transnasal pressure point and is expressed in $Pa/cm^3/s$. Rhinomanometery has been introduced as a suitable tool for assessing nasal airflow resistance. ***Cottle (1968)*** and others ***(Ingelstedt, Johnson and Rundcrantz, 1969; Kotekangas, 1971)*** have used rhinomanometery for several years. They have demonstrated that the method is not only easy, but also reveals the anatomy of nose better than the patients own evaluation. Another advantage is the reproducibility of the method. For some years efforts have been made to standardize the results obtained. ***Broms Johnson and Malms (1980)*** have worked upon this problem.

The international committee on standardization of rhinomanometery has recommended that nasal patency should be expressed as resistance, which is the ratio measurement of transnasal pressure and flow of respiratory air in patient breathing exclusively through nose.

Rhinomanometry has evolved in recent years as an objective measurement of airway resistance. One of the earliest methods of

measuring nasal airflow consisted of moving a pressure cannula along the nasal passage to measure pressure- flow relationships ***(Bridger, 1970)***. Active rhinomanometry refers to flow measurement from the respiratory cycle. The 3 types of active rhinomanometry include anterior, postnasal, and posterior rhinomanometry. Passive rhinomanometry uses airflow from an extrinsic source, such as an air pump ***(Kerr, 1997)***.

Anterior rhinomanometry measures unilateral airflow. Both nasal passages may be measured separately ***(Bailey, 1998)***. Anterior rhinomanometry and acoustic rhinomanometry are probably the most common methods of clinical measurement of airflow ***(Cummings, 1999)***.

Postnasal rhinomanometry is another form of measurement. Posterior rhinomanometry uses a pressure sensor in the mouth. In this method, total flow from both nasal passages can be measured together, or each nasal passage can be measured separately. One disadvantage of posterior rhinomanometry is that not all patients are able to relax the soft palate sufficiently. In addition, an oral pressure sensor may be prone to artifact due to movement in a patient's mouth ***(Bailey, 1998)***. A significant number of patients seem to be unable to be studied using rhinomanometry for various reasons.

Passive rhinomanometry relies on the production of airflow from

an external source. With a constant pressure, the flow is measured from the nasal mask. However, it has been noted that external introduction of airflow causes "reflex-evoked changes of the thickness of nasal mucosa" ***(Cummings, 1999)***. Accordingly, this method has found little clinical application.

Postnasal rhinomanometry uses a pressure sensor placed along the floor of the nose into the nasopharynx. A separate pressure transducer is located at the entrance of the nasal cavity ***(Cummings, 1999)***. Transnasal pressure differences are then measured.

Posterior rhinomanometry involves placing a pressure sensor trans orally into the posterior pharynx. Pressure differences from the nares to the nasopharynx are then measured. Total resistance is measured directly. In this method, patients must be coached to keep the intraoral tube in place ***(Bailey, 1998)***.

Rhinomanometry yields flow-pressure curves. Airflow increases with increased transnasal pressure, but higher pressures may yield turbulent flow secondary to the effects of airway resistance. Turbulent flow results in a limitation of flow generated despite greater transnasal pressure differences ***(Cummings, 1999)***.

As nasal obstruction occurs, the amount of flow able to be

generated plateaus sooner even with greater pressure changes.

The clinical value of rhinomanometry relates to degree of obstruction. The 2 major types of obstruction are mucosal hypertrophy and structural deformity. Rhinomanometry is performed with and without decongestion and total resistance is calculated. Resistance above 0.3 Pa/mL/s is usually symptomatic ***(Bailey, 1998)***. The one caveat of rhinomanometry is that no resistance can be measured when the nasal passage is completely obstructed.

Decongestion is used to determine a mucosal cause of nasal resistance. Marked reduction in resistance with decongestion suggests mucosal disease. Decongestion causing less than a 35% decrease in resistance suggests a structural cause of nasal obstruction rather than a mucosal cause ***(Bailey, 1998)***.

The latest introduction to our armamentarium is acoustic rhinomanometery. Hilberg has published convincing evidence that acoustic rhinometery provides the true crossectional area of nose.

Acoustic rhinomanometry is based on the analysis of a sound pulse generated into the nasal passages. The sound reflected from the nasal airway is transformed into an area-distance plot. The average distance of maximum constriction is within 2 cm ***(Cummings, 1999)***. ***Hilberg in***

1989 and ***Grymer in 1991*** demonstrated that cross-sectional area measurements correlated well with radiologic measurements of nasal airway constriction *(Grymer, 1989, 1991)*.

Warren's analysis of rhinomanometeric values determined the minimal cross-sectional area of nasal cavity of 0.4 cm square below which the individual will change the mode of respiration to predominantly oral. ***Paulo Borges Dinis*** and ***Haula Haider*** in their study "Septoplasty : Long-term evaluation of results" published in American Journal of Otolaryngology found that subjects with anterior septal deformities were shown to benefit most from septoplasty. They found that selection of patients alone does carry, however, a considerable risk of patient dissatisfaction with end results.

L.F.Grymer, D. Elbrond : (1989 Laryngoscope) evaluated the nasal cavity with septal deviation before and after septoplasty by acoustic rhinometery and found acoustic rhinometery very suitable in such studies.

A study "Mucosal congestion in patients undergoing septoplasty" in ENT Department, Turku University Central Hospital,Turkufound).

Both deviant anatomy of the nasal cavity and congestion of the nasal mucosa may lead to increased nasal patency. In this study pre and postoperative anterior active rhinomanometry was recorded with both

baseline and decongestion measurements in 102 consecutive patients operated on because of marked septal deviation. The operation succeeded to lower the baseline values in cases were decongestion recordings gave almost similar results both in pre and postoperative measurements. It can also be concluded that in patients whose septal pathology is so marked that it has caused an elevated NAR in preoperative decongestion measurements, there is also a clear component of nasal mucosal congestion, which can be measured with rhinomanometry as a higher decongestion effect than in the group with minor septal deviations, and lower NAR.

Material & Methods

MATERIAL AND METHODS

The present study was conducted on 35 patients visiting the department of otolaryngology, MLB Medical College & Hospital, Jhansi during the period of July 2004 to August 2005.

Clinical study

Selection of patients was based upon recognized signs and symptoms attributed to DNS e.g. Nasal obstruction, Headache, Recurrent sinusitis, Middle ear infections & Epistaxis with special attention to nasal obstruction. All selected patients were subjected to detailed :-

1) History : Special attention was done on following points –

- Nasal obstruction/difficulty in breathing through nose
- Nasal discharge : clear/ purulent/ mucopurulent
- Foul smelling/ non foul smelling
- Recurrent attacks of colds
- Headache/ no headache
- Sneezing
- Epistaxis
- PND/ Irritation in throat
- Ear discharge

2) Clinical Examination

- Local – Anterior and posterior rhinoscopy
- Systemic Examination

3) Blood Investigation

- Haemogram – Hb, TLC, DLC, ESR
- Essential blood tests – Absolute
- Eosinophil count, VDRL

4) Radiological studies

- X-ray PNS occipitomental view (water's view)
- CT PNS

5) Nasal airflow studies

- Rhinomanometry

6) Diagnostic endoscopy in some selected cases.

The patients will consists of these groups -

i) Patients with anterior DNS and with or without lateral wall pathology.

ii) Patients with posterior DNS with or without lateral wall pathology.

iii) Combination of above two groups and with or without lateral wall pathology.

iv) Patients without nasal symptoms and with normal clinical examination (control group).

The types of septal deformities were divided on the basis of location i.e. anterior or posterior. Septal deformities were classified as anterior if located in the caudal end of the septum and/or in the valve area; and posterior if located in the caval portion of the nasal cavity, posterior to pyriform aperture.

Those patients who received multiple courses of antibiotic for treatment of maxillary sinusitis and were not relieved of symptoms were also included in this study.

In this study, patients who had any type of sinus surgery in the past were excluded from this study. Very old patients, pregnant women and those who could not withstand septoplasty under local anaesthesia due to mental and physical ailments were also excluded from the study. Similarly those who were not agreeable for septoplasty were also excluded.

A thorough present and past history were taken and the patients were questioned regarding any type of treatment taken before. The

patients underwent detailed clinical examination including anterior rhinoscopy and posterior rhinoscopy.

From the standardized preoperative interview concomitant disease, medication (especially antiallergic, cardiorespiratory and psycotropic drugs) history of previously diagnosed respiratory allergy, as well as drug and food allergy were recorded.

All those patients considered to be allergic who had symptoms of allergic rhinitis (sneezing, blockage, discharge) for atleast 2 years.

Radiological studies – All patients were subjected to radiological study by doing X-ray PNS OM view and CT PNS screening. On X-ray PNS posterior DNS or any bony spur was looked for. Cartilaginous deviation is not seen on X-ray PNS. Chronic sinusitis was looked and was judged to be present, when the roentgenographic studies showed mucosal thickening and on air fluid level or complete opacification of maxillary sinus. The degree of mucosal thickening was evaluated by noting the nearest distance between the air mucosal interface and the lateral part of the sinus wall (mucosal thickening was defined as a mucosal width of 5.5mm or more) by ***Itzhal brook (1994)***.

CT PNS screening was done after 3 weeks of antibiotic therapy, to look for type of DNS and associated lateral wall pathology like concha

bullosa, double middle turbinate, paradoxical turbinate, rotated uncinate process, Hallar cells, inferior turbinate hypertrophy, enlarged bulla ethmoidalis etc.

Endoscopic studies – In some cases diagnostic endoscopy using 30°. 4mm endoscope was done. It was done under surface anaesthesia with cotton swabs socked in 2% xylocaine solution with 1:200000 adrenaline placed in each nasal cavity. These cotton pledgets lie against nasal mucosa of the septum and turbinate from roof to floor and from anterior nares to posterior choana one over the other. These were placed for 5-10 min. Procedure was done in lying down position. All these passes of endoscopy were performed and looked for drainage system, dynamics of Eustachian tube, site, extent and type of pathology in osteomeatal complex anterior and posterior.

Airflow studies

The nasal airflow studies were conducted in the selected patients and in a control group.

The apparatus we used was a self made device simulating rhinomanometer. The air flow was measured as a function of change in the height of air column during quite breathing.

As per the recommendations of 'international committee for standardization of rhinomanometry' the rhinomanometry was performed in decongested nose during quite inspiration. As discussed before, the air flow was measured as a function of rise in height of water column. The air flow through each nostril was individually measured by a probe placed in such a way that it snugly fitted into the nasal vestibule, care was taken not to distort the nasal valve so as to avoid spurious results.

The patients clinical profile was simultaneously reviewed and following aspect were considered : age at the time of surgery, sex, other nasal signs and symptoms and the type of septal deformities.

The study design and statistics involved :

Thirty five patients who were selected for septoplasty were examined rhinomanometrically after decongestion by topical xylometazoline. Each nostril was measured individually during quite inspiration. Three consecutives values were taken and the mean was calculated.

Then the air flow value of the right nostril and the left nostril were compared by applying students' T test.

Simultaneously a control group of 20 patients without any obvious DNS and obstructive symptom were selected as control. They were

subjected to rhinomanometry similar to the study group. The P value was calculated by applying student T test to check the significance. To nullify the effect of nasal cycle xylometazoline was used topically.

The study group was subjected to septoplasty/ SMR. After a month of operation the subjects were again examined rhinomanometrically after decongestion in a way similar to previous examination. The values calculated were compared with the preoperative values and the P value was calculated by applying 'Paired T test' to see if there was significance difference in nasal air flow after the operative procedure.

P values <0.01 were considered highly significant i.e. the difference in air flow was not by chance, the value, <0.05 was also considered significant. The P values of >0.05 were considered not significant.

Along with rhinomanometry patients were subjected to questionnaire regarding improvement in other symptoms was also recorded.

The patients response was measured in terms of :

+++	Very good
++	Good
+	Fair
—	no improvement

Finally the rhinomanometric findings were compared with the amount of subjective relief.

Observations

OBSERVATIONS

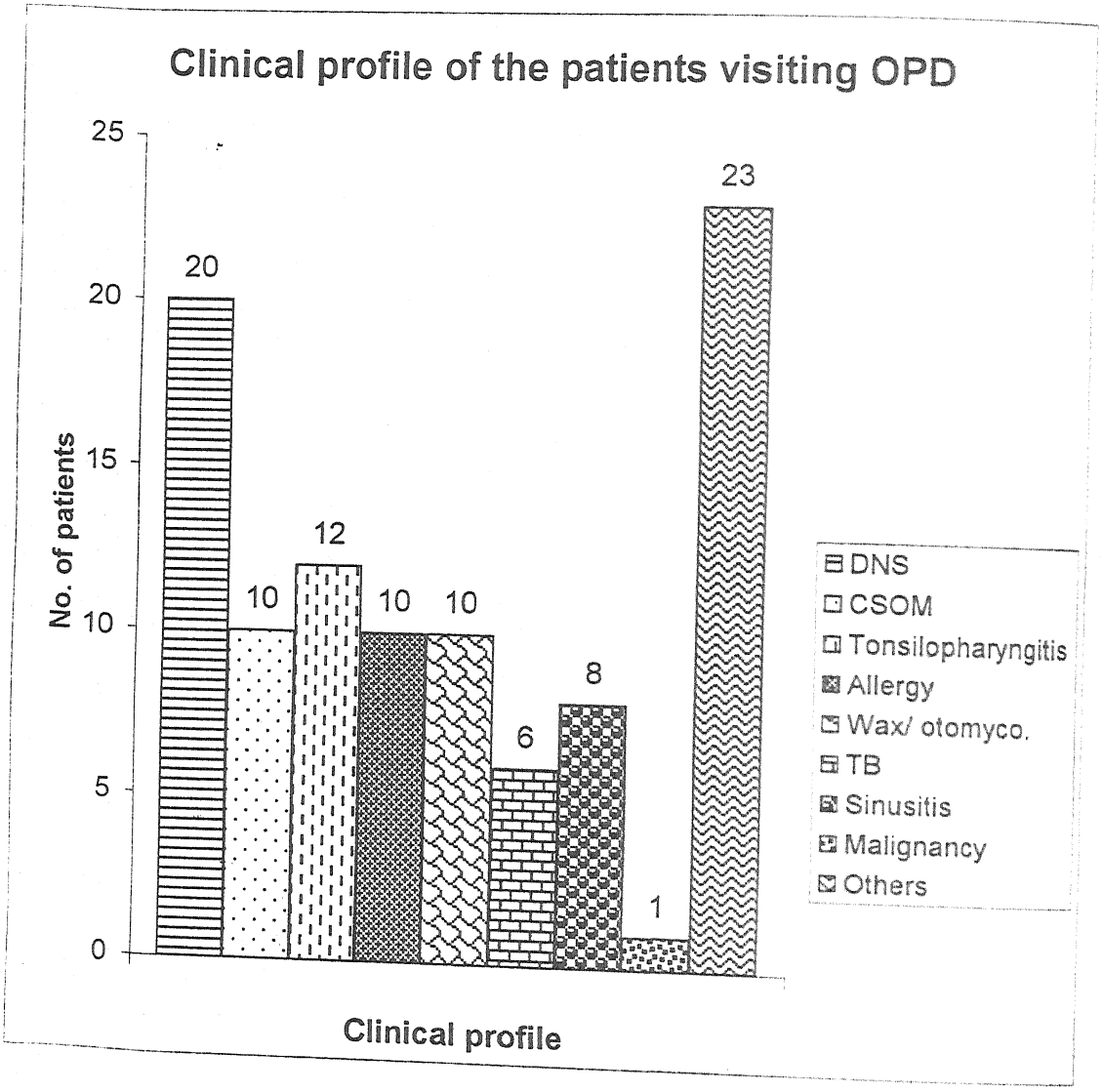
TABLE-1

Clinical profile of the patients visiting out patient department

Clinical profile	No. of patients	Percentage
DNS	20	20.0%
CSOM	10	10.0%
Tonsilopharyngitis	12	12.0%
Allergy	10	10.0%
Wax/ otomyco.	10	10.0%
TB	6	6.0%
Sinusitis	8	8.0%
Malignancy	1	0.5%
Others	23	23.5%

The graph shows the usual profile of patient attending our OPD.

The patient with DNS constituted 20% of our patients.


Clinical profile of the patients visiting OPD
No. of patients
25
20
15
10
5
0
20
10
12
10
10
6
8
1
23
DNS
CSOM
Tonsilopharyngitis
Allergy
Wax/ otomyco.
TB
Sinusitis
Malignancy
Others
Clinical profile

OBSERVATIONS

TABLE-1

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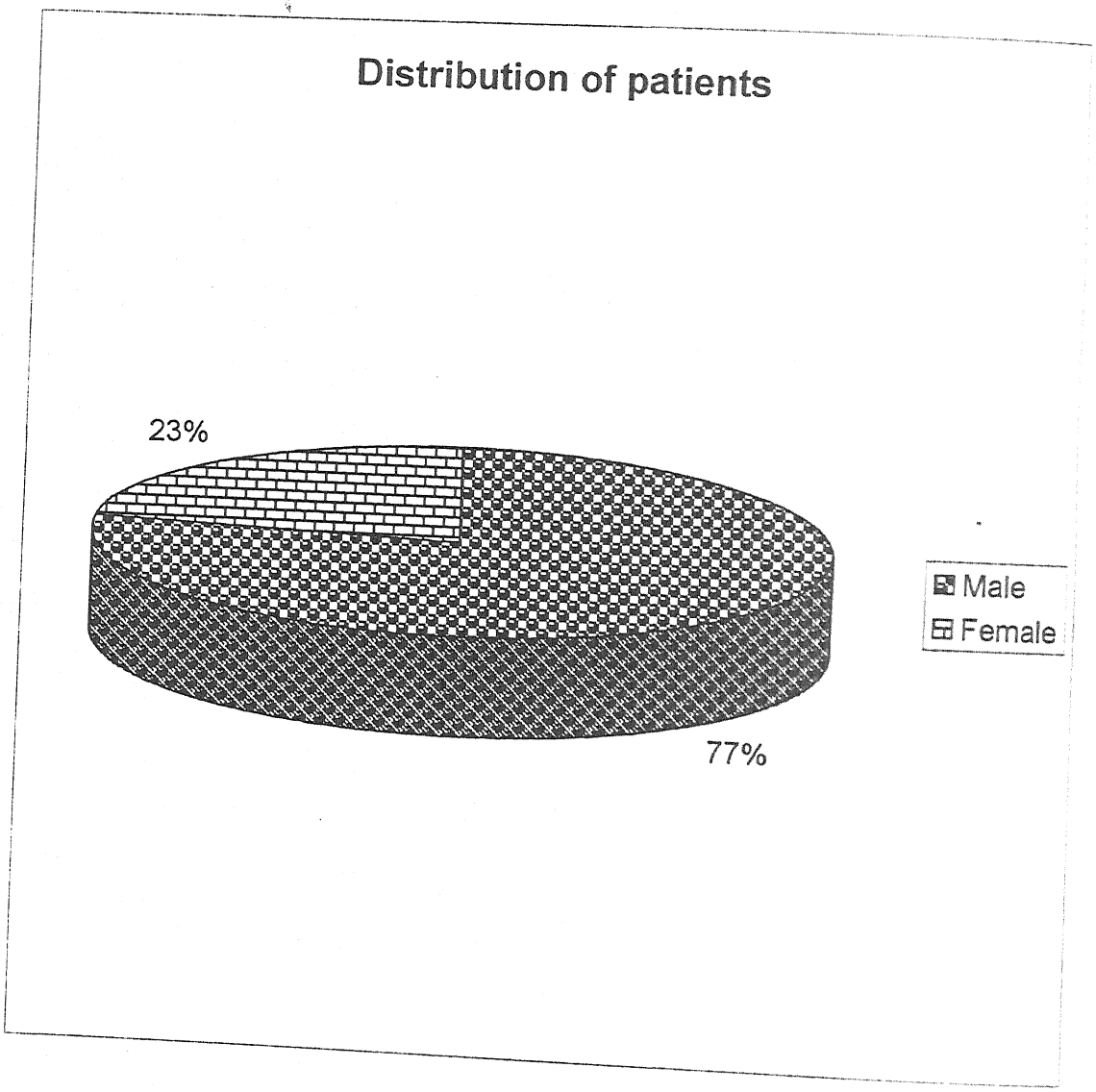

Distribution of patients
23%
77%
Male
Female

TABLE-2

Distribution of patients in relation to sex in cases of patient with DNS and associated nasal pathology

Sex	No. of cases	Percentage
Male	27	77%
Female	8	23%

Twenty three percent our patients were females rest were males. The difference seems to be because of social factors rather than the pathology of DNS being more common in males.

TABLE-3

Distribution of type of DNS in relation to sex

Sex	Anterior DNS	Posterior DNS
Male	17	10
Female	5	3

The above graph shows that anterior DNS is more common in both males and females than posterior DNS.

TABLE-4

Distribution of unilateral or bilateral DNS in relation to sex

Sex	Unilateral DNS	Bilateral DNS
Male	14	13
Female	3	5

Our study shows that unilateral DNS is more common in males whereas in females bilateral DNS is common.

TABLE-5

Distribution of lateral wall pathology in relation to sex

Lateral wall pathology	Male	Female
Compensatory ITH	15	5
Bilateral ITH	13	4
Concha Bullosa	11	7
Enlarged bulla ethmoidalis	10	3
Enlarged uncinate process	9	3
Maxillary / Pansinusitis	17	6
Polyposis	14	4

Our study shows that compensatory ITH on opposite side is most common lateral wall pathology followed by bilateral ITH in both males and females.

TABLE-6

Distribution of number of cases in relation to age

Age	No. of cases	Percentage
0-10	1	2.8
10-20	9	25.7
20-30	15	42.8
30-40	7	20.0
40-70	3	8.5

The chart shows that DNS is more common in the age group of 20-30 years and least common in the age group of 0-10 years.

TABLE-7

Distribution of type of DNS in relation to age

Age	Anterior DNS	Posterior DNS
0-10	2	1
10-20	8	2
20-30	13	8
30-40	9	7
40-70	3	1

Our study shows that both Anterior as well as posterior DNS is common in age group of 20-30 years.

TABLE-8

Distribution of Unilateal ir Bilateral DNS in relation to age

Age	Unilateral DNS	Bilateral DNS
0-10	2	1
10-20	17	12
20-30	23	11
30-40	11	7
40-70	2	1

Above chart shows that unilateral DNS is common in age of 20-30 yeasr where as bilateral DNS is common in age of 10-20 years.

TABLE-9

Symptoms in relation to Anterior DNS

Symptoms	Ant. DNS/Spur	Percentage
Nasal Obstruction	33	33
Nasal discharge	25	25
PND	18	18
Headache	20	20
Ear discharge	4	4

Our study shows that in anterior DNS nasal obstruction is the commonest symptom followed by nasal discharge and headache.

TABLE-10

Symptoms in relation to Posterior DNS

Symptoms	Posterior DNS/ Spur	Percentage
Headache	32	32
Vertigo	19	19
Mastoid and occipital pain	17	17
Tinnitus	12	12
PND	16	16
Nasal Obstruction	5	5
Nasal discharge	13	13
Ear discharge	6	6

In posterior DNS headache is the most common symptom (32%) followed by vertigo (19%), mastroid pain (17%), PND (16%) and tinnitus (12%).

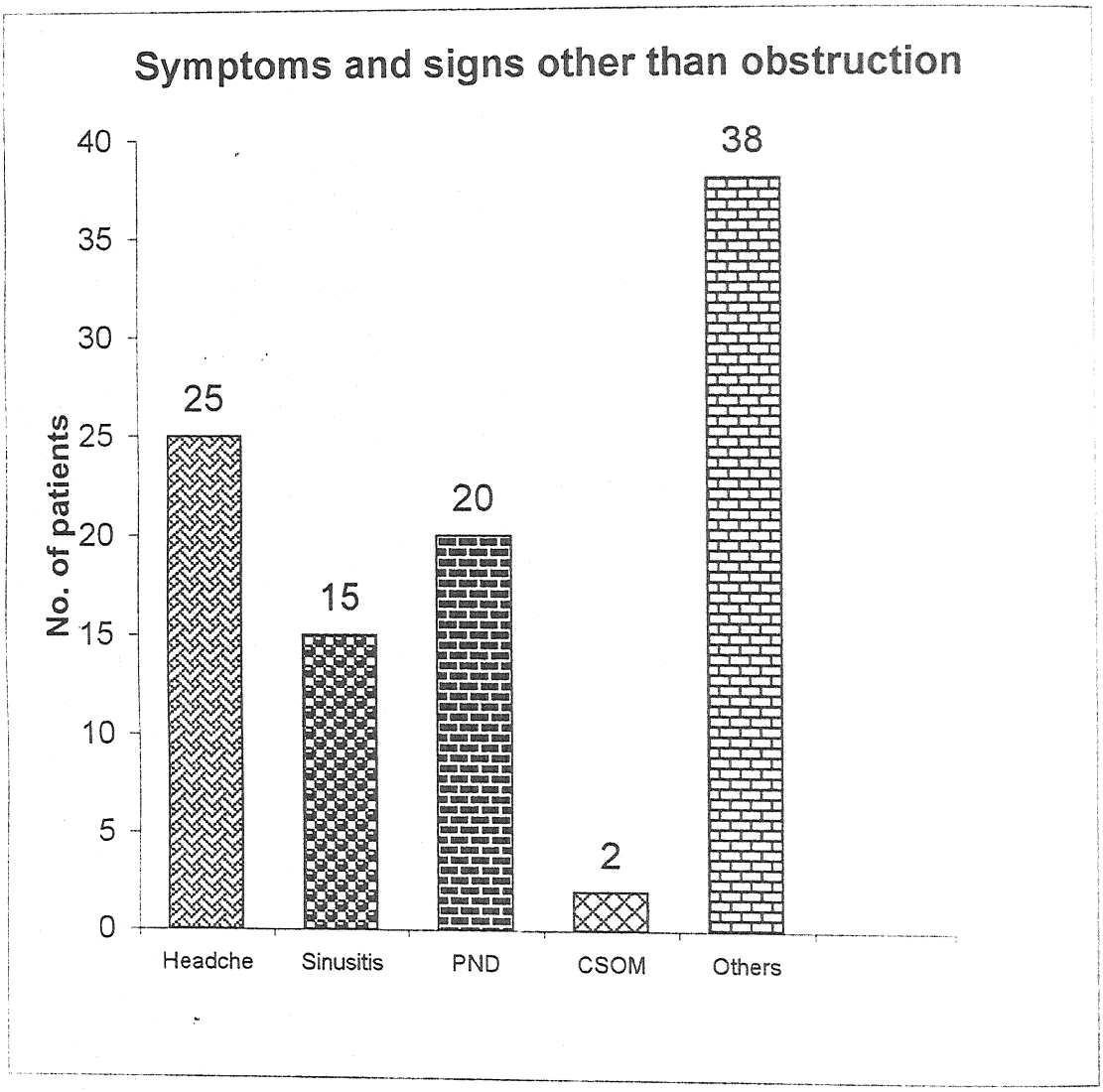

Symptoms and signs other than obstruction
No. of patients
40
35
30
25
20
15
10
5
0
25
15
20
2
38
Headche
Sinusitis
PND
CSOM
Others

TABLE-11

Symptoms other than obstruction in Anterior and posterior DNS

	No. of patients	Percentage
Headache	25	25.0
Sinusitis	15	15.0
PND	20	20.0
Ear discharge	2	2.0
Others	38	38.0

The graph shows symptoms and signs we came across in some patients with DNS along with nasal obstruction.

We found that 25% of our patients complained of headache, 15% of our patients had sinusitis, 20% of our patient had post nasal drip and 2% had ear problem. Nasal obstruction was common to all patients except a few who had posterior isolated spurs.

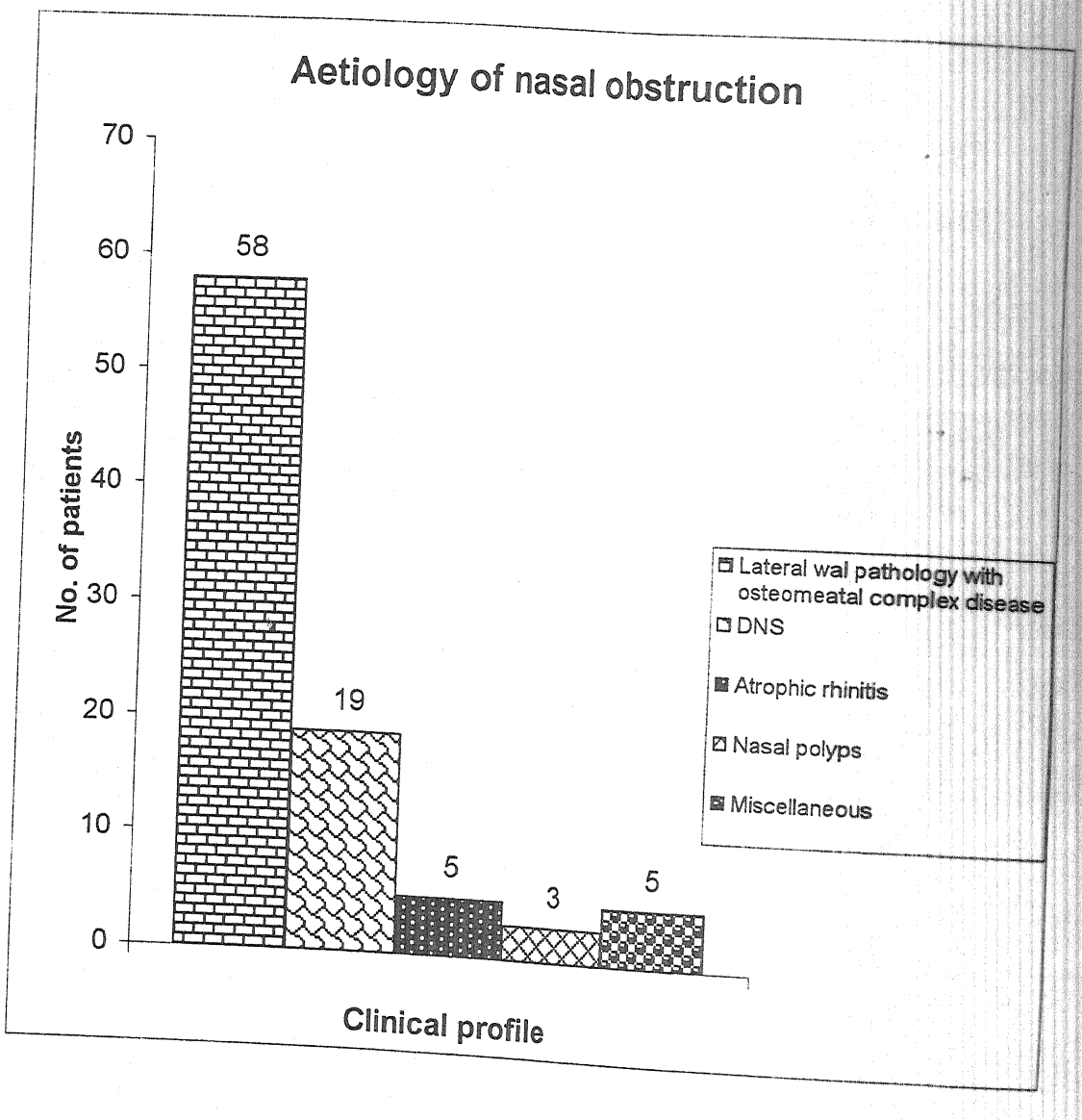

Aetiology of nasal obstruction
70
60
50
40
30
20
10
0
No. of patients
58
19
5
3
5
Lateral wal pathology with osteomeatal complex disease
DNS
Atrophic rhinitis
Nasal polyps
Miscellaneous
Clinical profile

TABLE-12

Aetiology of Nasal Obstruction in Adults

Cause of Obstruction	No. of cases	Percentage
Lateral wall pathology with osteomeatal complex disease	58	57.9
DNS	19	18.60
Atrophic rhinitis	5	5.0
Nasal polyps	3	3.0
Miscellaneous	5	5.50

The graph shows the main causes of nasal obstruction. We found that lateral wall pathology with osteomeatal complex disease which is multifactorial in aetiology seems to be most common pathophysiological cause of nasal obstruction which constitutes 57.9% of cases with nasal obstruction; septal deformities are the most common anatomical cause which constitutes 18.6% of cases. One thing is worth observing that septal deformity can be an indirect cause of nasal obstruction by being an aeitological factor in chronic rhinitis. Other causes of nasal obstruction are nasal polyps, atrophic rhinitis and miscellaneous causes.

As far as chronic rhino sinusitis is concerned it is a very broad term, and is multifactorial in aetiology. It might as a consequence of secondary effects of DNS e.g. maxillary sinusitis, pansinusutis, compensatory

turbinate hypertrophy and reflex swelling of turbinates as a result of sinusitis or because of concha bullosa, osteomeatal complex disease allergy and polyps etc.

TABLE-13

Type of DNS according to shape

DNS	No. of patients	Percentage
C shaped	12	34.2
S shaped	10	28.5
Ant. Spur with opposite DNS	8	22.8
Anterior and posterior vomerine spur	3	8.5
DNS with consertina due to trauma	2	5.7

In our study we found that C shaped DNS (34.2%) is most common followed by S shaped (28.5%), then anterior spur with opposite DNS (22.8%).

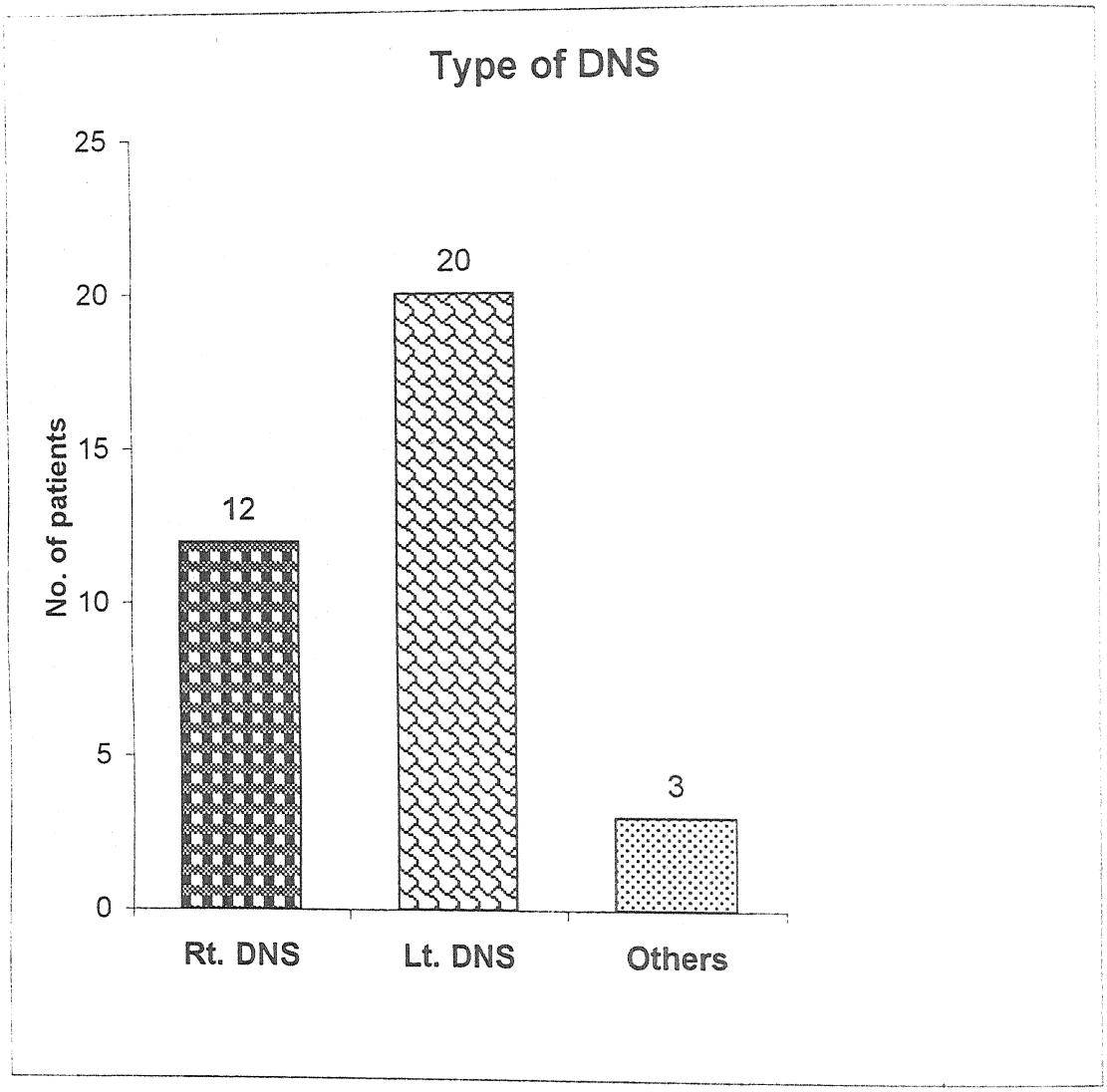

Type of DNS
No. of patients
25
20
15
10
5
0
12
20
3
Rt. DNS
Lt. DNS
Others

TABLE-14

Type of DNS

DNS	No. of patients	Percentage
Rt. DNS	12	34.28%
Lt. DNS	20	57.14%
Others	3	8.58

We also tried to evaluate the incidence as far as side (right or left) was concerned. We found that out 35 patients we examined 20 had left sided DNS and 12 had right sided DNS and the remaining 3 had irregular DNS involving both sides.

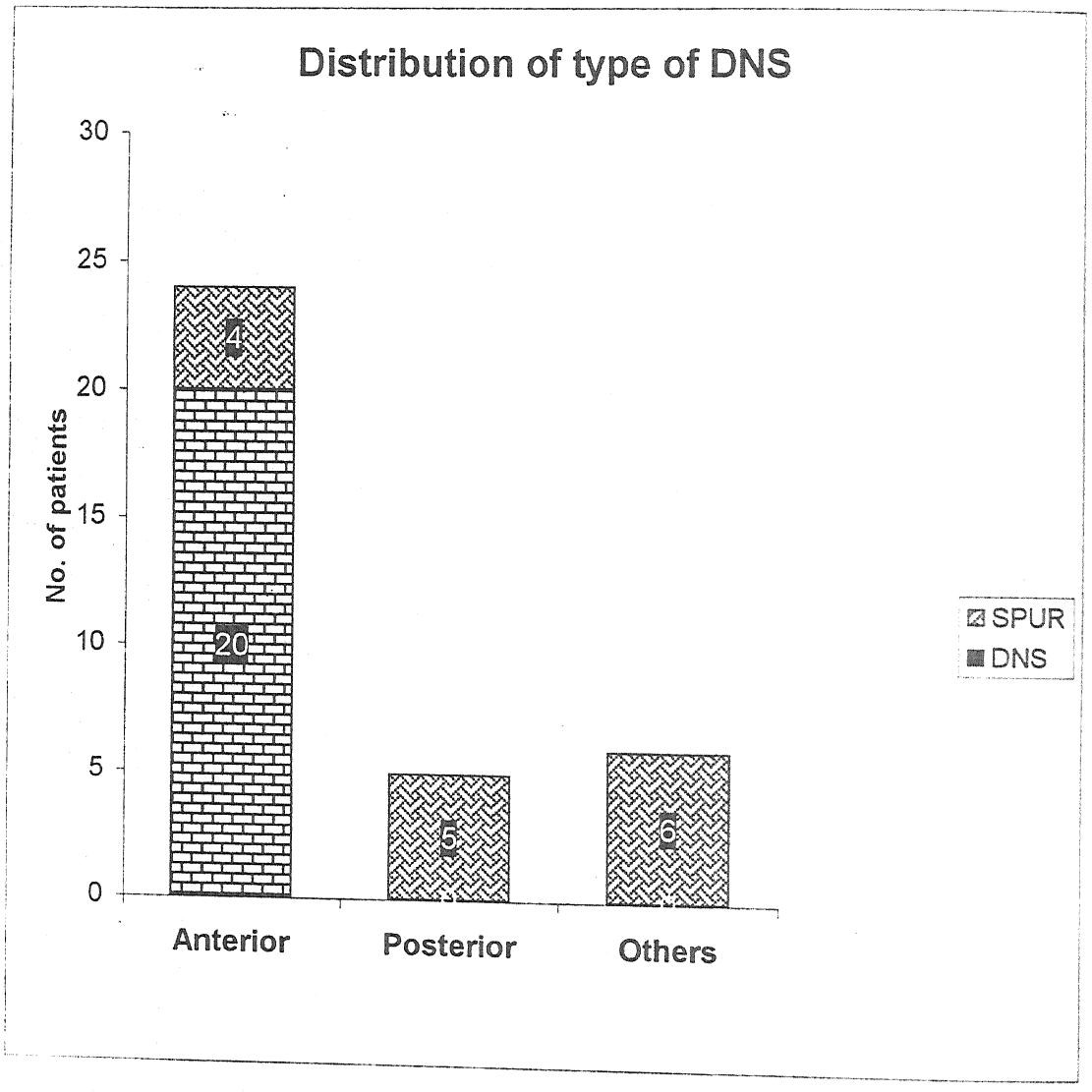

Distribution of type of DNS
No. of patients
30
25
20
15
10
5
0
4
20
5
6
Anterior
Posterior
Others
SPUR
DNS

TABLE-15

Distribution of type of DNS

Type of DNS	No. of patients	
	DNS	SPUR
Anterior	20	4
Posterior	5	0
Others	6	0

In our study we classified the septal deformities on the basis of location into anterior and posterior. Deviation in the region of caudal septum and/or valve was considered anterior; where as deviation in the cavum of nose behind the pyriform aperture was considered posterior. We found that out of 35 patients we examined, 20 patients had deviation of septum in the anterior part which 4 patients had anteriorly placed spurs mainly in the basal region extending into the cavum for a variable distance along the cartilage and premaxillary junction, 5 patients had spurs placed posteriorly, but no smooth deviation was found poteriorly, and the remaining 6 patient had irregular DNS.

TABLE-15

Distribution of type of DNS

Type of DNS	No. of patients	
	DNS	SPUR
Anterior	20	4
Posterior	5	0
Others	6	0

In our study we classified the septal deformities on the basis of location into anterior and posterior. Deviation in the region of caudal septum and/or valve was considered anterior; where as deviation in the cavum of nose behind the pyriform aperture was considered posterior. We found that out of 35 patients we examined, 20 patients had deviation of septum in the anterior part which 4 patients had anteriorly placed spurs mainly in the basal region extending into the cavum for a variable distance along the cartilage and premaxillary junction, 5 patients had spurs placed posteriorly, but no smooth deviation was found poteriorly, and the remaining 6 patient had irregular DNS.

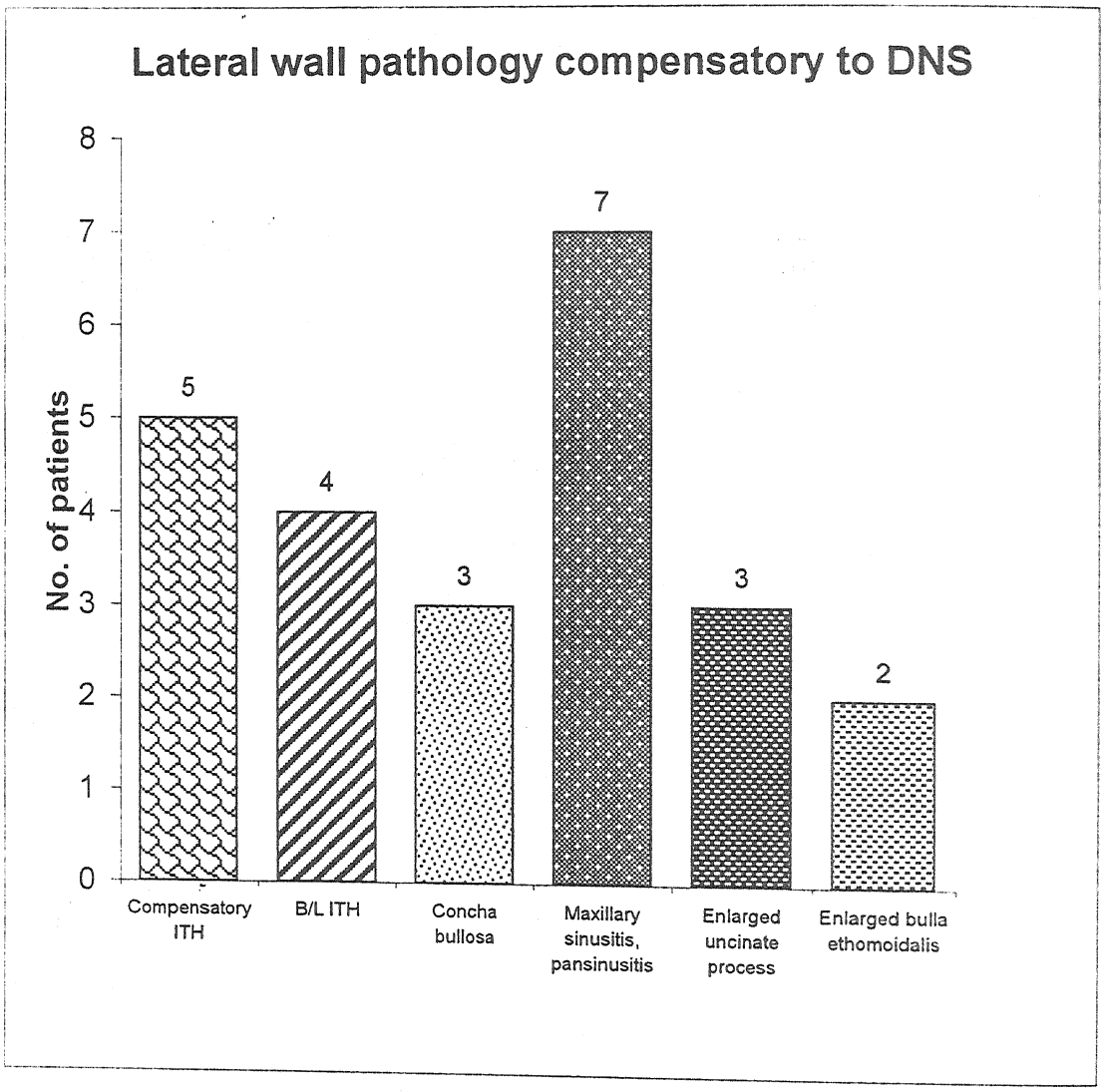

Lateral wall pathology compensatory to DNS
No. of patients
0
1
2
3
4
5
6
7
8
5
4
3
7
3
2
Compensatory ITH
B/L ITH
Concha bullosa
Maxillary sinusitis, pansinusitis
Enlarged uncinate process
Enlarged bulla ethomoidalis

TABLE-16

Associated pathology along with DNS encountered during nasal examination

Pathology	No. of patients	Percentage
Compensatory ITH	5	14.29
B/L ITH	4	11.42
Concha bullosa	3	8.57
Maxillary sinusitis, pansinusitis	7	20.0
Enlarged uncinate process	3	8.5
Enlarged bulla ethomoidalis	2	5.7

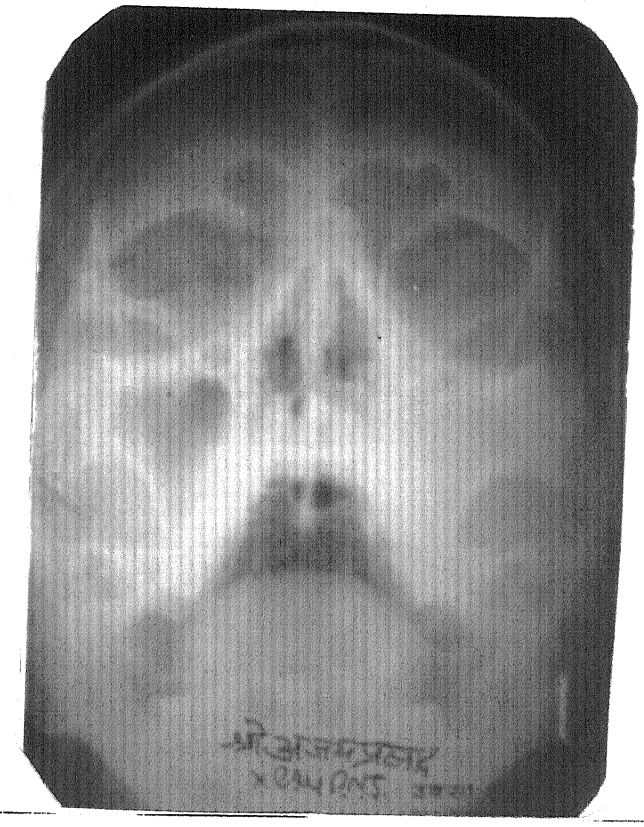
Out of 35 patients we examined lateral wall pathology was frequently encountered; this was probably because of the compensatory effects of deviated nasal septum. The frequency of occurrence of lateral nasal wall pathology is as above.

TABLE-17

Type of Headache due to DNS

Type	No. of cases
Unilateral	55
Bilateral	45
Temporal	35
Frontal	27
Between the eye	30
Vertex	8
With vomiting	26
With exercise or work	7
With dehydration	5
Migrane like / vascular headache	2

We found that unilateral headache due to DNS is more common than bilateral and temporal headache is more common than frontal or between the eye headache. 26 patients had headache with vomiting. We also found migrane like or vascular headache in 2 of our patients.



X-ray showing - Bilateral haziness endoscopy shows inspissated pus and polyp

X-ray showing - Unilateral haziness of maxillary sinus thick purulent pus

TABLE-18

Radiological finding of DNS

Findings	No. of cases
Maxillary sinus haziness	13
Frontal sinus haziness	6
Ethmoidal haziness	5
Loss of scalloping in frontal sinius	2
Demineralization of boundaries of sinuses	2
Haziness of nasal passage	7

Our study shows that haziness in maxillary sinus is the commonest finding in radiological examination followed by frontal and ethomoidal sinus. We also found loss of scalloping in frontal sinus in 2 patients which suggests mucocele of the frontal sinus. Demineralization of boundaries of sinuses also seen due to chronic sinusitis leading to dissolution of bone.

TABLE-19

Radiological finding of unilateral and Biltaeral DNS

Type	No. of cases	Percentage
Unilateral DNS	15	60
Bilateral DNS	12	40

Unilateral DNS (60%) is more common than bilateral DNS (40%).

X-ray showing - Unilateral right maxillary haziness endoscopy showed polyp

X-ray showing - Unilateral haziness of maxillary sinus AP lavage shows mucopurulent pus

TABLE-20

Radiological finding of Lateral wall pathology associated with DNS

	No. of cases	Percentage
ITH compensatory	4	16
Bilateral ITH	5	20
Concha bullosa	4	16
Maxillary sinusitis/ pansinusitis	7	28
Polyposis	5	20

In radiological evaluation maxillary/pansinusitis is the commonest finding followed by bilateral ITH and polyposis.

TABLE-21

Rhinomanometric finding in control patients

Findings (cm of water)	No. of cases
1.0-1.2	12
1.2-1.4	15
1.4-1.6	18
1.6-1.8	14
1.8-2.0	8
2.0-3.0	4

We have found that all the control cases have rhinomanometric finding between 1-3 cm of water. Out of which maximum number of patients have finding between 1.4-1.6cm of water.

TABLE-22

Rhinomanometric findings in DNS patients associated with lateral wall pathology

Pathology	Finding (cm of water)
Anterior DNS	0.3-0.4
Posterior DNS	0.7-0.9
DNS with spur (Bilateral)	0.4-0.5
Only spur	0.5-0.6
With concha bullosa	0.4-0.6
With ITH	0.2-0.3
With enlarged ethmoid bulla	0.5-0.6
With enlarged uncinate process	0.4-0.5

From the above chart we can see that the anterior DNS causes maximum obstruction than posterior DNS. If there is associated ITH along with DNS than the obstruction increases to maximum.

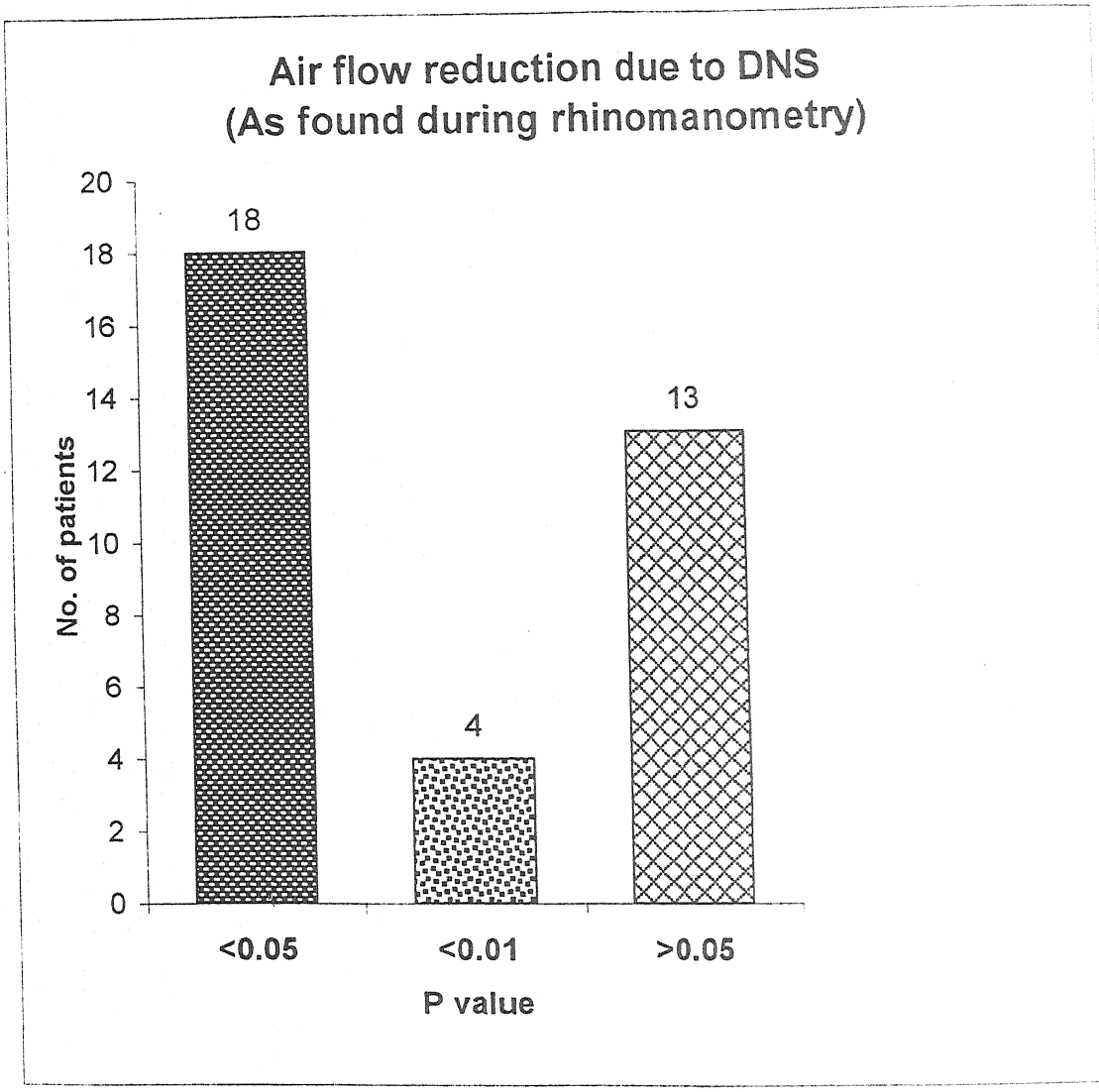

Air flow reduction due to DNS
(As found during rhinomanometry)
No. of patients
20
18
16
14
12
10
8
6
4
2
0
18
4
13
<0.05
<0.01
>0.05
P value

TABLE-23

Air flow reduction due to DNS

p value	No. of patients	Percentage
<0.05	18	51.42
<0.01	4	11.42
>0.05	13	37.14

On applying test for significance we fond that 18 patients had significant difference in there nasal airflow because of DNS, 4 patients had highly significant obstruction because of DNS and 13 patients did not had significant change in airflow.

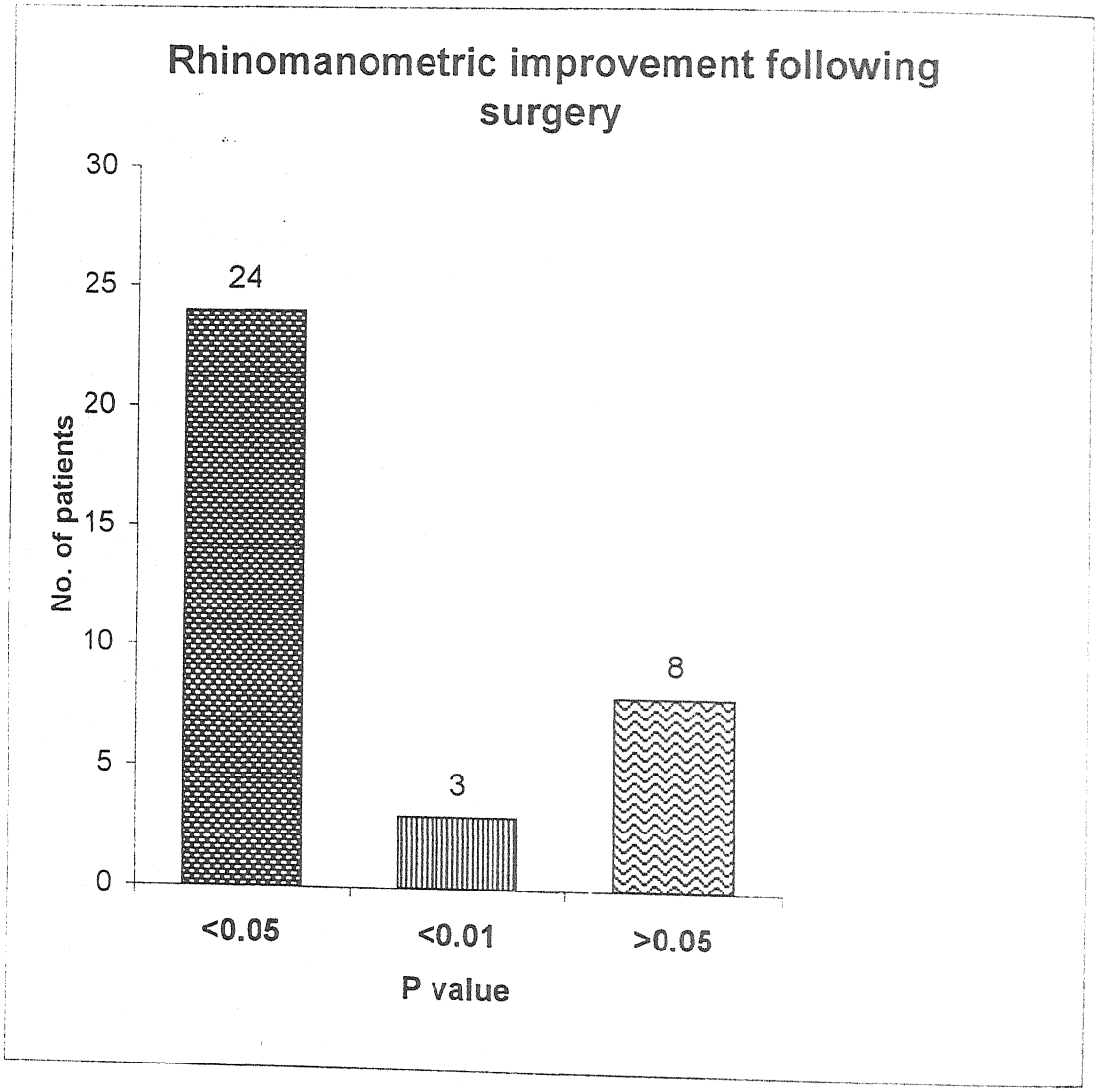

Rhinomanometric improvement following surgery
30
25
20
15
10
5
0
No. of patients
24
3
8
<0.05
<0.01
>0.05
P value

TABLE-24

Rhinometric improvement following surgery

p value	No. of patients	Percentage
<0.05	24	68.57
<0.01	3	8.57
>0.05	8	22.86

When we compared the rhinomanometric data obtained preoperatively with the postoperative data by applying test for significance, we found 24 patients had significant improvement in there nasal aerodynamics after septoplasty/SMR, 3 patients had highly significant improvement and 8 patient had insignificant improvement, but some of the non improved patients had improvement in other symptoms e.g. headache, sinusitis.

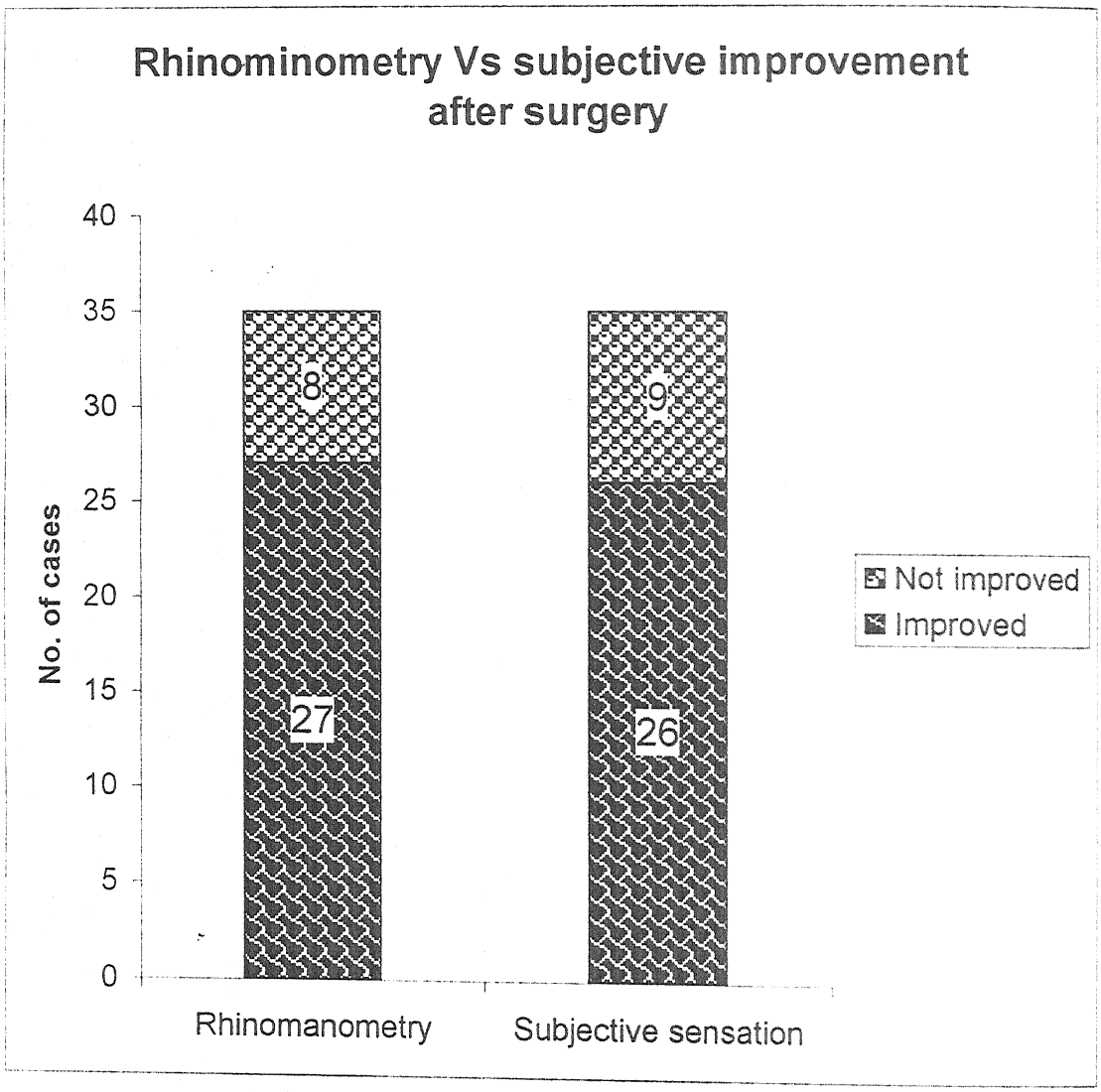

Rhinominometry Vs subjective improvement after surgery
No. of cases
40
35
30
25
20
15
10
5
0
8
27
9
26
Rhinomanometry
Subjective sensation
Not improved
Improved

TABLE-25

Comparison between subjective sensation and rhinometric findings

	No. of Patients	
	Improved	Not improved
Rhinomanometry	27	8
Subjective sensation	26	9

We also compared the rhinomanometric improvement with the improvement in subjective sensation of air flow after septoplasty/SMR. We found that 27 patients showed rhinomanometric improvement as compared to 23 which showed subjective improvement. Causes of no improvement in rhinomanometry are failure to correct DNS, leaving posterior and of enlarged inferior terminate, leaving lateral wall pathology unoperated.

Discussion

DISCUSSION

The nose is the guardian angel of the respiratory tract. It has several important physiological functions, which include air-conditioning, filtering inspired air, and olfaction. The nasal mucosa also has an important immunologic role in defending against inhaled foreign pathogens and allergens. To serve these important functions, a patent nasal passage is needed.

Nasal obstruction is a common symptom, which is difficult to quantify clinically. The etiologic factors for nasal obstruction include anatomic variations of the nose and various local and systemic diseases. Hence, objective assessment of the nasal airway will aid diagnosis, treatment research and medico - legal documentation.

Our study mainly concentrated on the evaluation of clinical radiological and rhinomanometrical differences in the anterior and posterior DNS and the extent of improvement in symptoms and pathological changes that have occurred in the nasal cavity after surgery. The other objectives of our study were to find out the relative occurrence of anterior and posterior DNS in Bundelkhand region, to find out the effect of DNS (anterior and posterior) on the same side and opposite side lateral wall structure, to evaluate whether the post-operative

rhinomanometric decrease in nasal resistance corresponded with the subjective relief in nasal patency of the patient and whether there was improvement in other associated symptoms such as headache, sinusitis and PND etc.

As far as incidence is concerned, we found that DNS causing obstruction was found in 20% of our patients visiting OPD. Other than direct symptoms of obstruction DNS was also responsible for much other nasal and extra nasal pathology e.g. chronic rhino sinusitis, headache, PND, inferior turbinate hypertrophy, SOM, CSOM, unilateral rhinitis, concha bullosa, epistaxis etc.

We found that DNS was fairly common in males. When compared to other studies, ***(Otolaryngologic clinic of North America-vol22, 2; April 1989; Ann Otol Rhinol 87th suppl. 3-20, 1980)*** the incidence in males was much higher than the world average. This difference seems to be because of social factors. The males in this part are much more out going as compared to females and they indulge in outdoor activities like driving, playing, farming, labor etc. making them much more prone to accidents. Females on the other hand face much of social restrictions and are confined to home and are concerned with house keeping. Also in this area the literacy and per capita income is low so the violence and crime rate is much higher. People indulge in fights very often and nose is

frequently involved in the scuffle, thus making DNS even more common in males.

We had also seen that anterior DN is more common in both males and females where as males have more common unilateral DNS as compared to females who have bilateral DNS as common feature. As far as lateral wall pathology is concerned with relation to sex we found that ITH on opposite side is most common lateral wall pathology followed by bilateral ITH in both males and females.

We also found that DNS is more common in the age group of 20-30 years. It may also be due to much more outgoing and much more prone to accidents.

Our study also focuses symptoms in relation to anterior and posterior DNS. We found that nasal obstruction (33%) and nasal discharge (25%) are the commonest symptoms in patients with anterior DNS followed by headache (20%) and PND (18%) whereas the commonest symptom in posterior DNS is headache (32%) followed by vertigo, mastoid pain, PND and tinnitius (Table – 9-10). This shows that anterior DNS causes more of the nasal obstruction than posterior DNS leading to stasis of secretion and causing chronic rhinosinusitis.

On radiological evaluation haziness in sinuses, loss of scalloping of frontal sinus, demineralization of boundaries of sinuses and haziness of nasal passage was formed in association with the DNS. We found haziness in maxillary sinus as the commonest pathology. It may be due to chronic sinusitis with fluid level or polypoid changes or mucosal hypertrophy. We also found loss of scalloping in frontal sinus in 2 of our patients which suggests mucocele of the frontal sinus.

In our study the septal deformities were classified according to the location in the anterior and posterior part of the septum. This simple classification is relevant considering anatomic and rhinomanometric studies of the nasal cavity. We arbitrarily divided DNS on the basis of position i.e. anterior or posterior, and on the basis of shape i.e. C shaped, S shaped, Spur and others. (Table - 13 & 14).

We found that anterior (up to lower end of upper lateral cartilage) DNS was far more common and was found in 24 of the 35 patients. Out of these 24 patients, 4 had spurs which also extended posteriorly along the cartilage and premaxillary junction. Posteriorly only spurs were found in 5 out of the 35 patients. Remaining 6 patients had irregular DNS, which was difficult to classify. (Table - 13 & 14). Higher incidence of anterior DNS has also been shown in a study "The problem of nasal obstruction " by *Charles P et al: April 1989* .

We found that the rhinomanometery after decongestion is a useful tool in selecting patients whom one may expect to benefit from septal surgery. Septoplasty and long term evaluation of results by ***Paulo Borges et al in march 2002***, the reason behind this is that septoplasty is a commonly performed procedure in otolaryngology and patient selection relies largely on clinical judgment. It has been found that many a time the patient is less than satisfied after surgery, one important reason for this that simple clinical evaluation may sometimes not be sufficient in selecting the patient. Our study emphasizes on the fact that addition of a simple investigation like rhinomanometery seems to be very useful for either selecting or excluding patients to undergo surgery. This has been also been emphasized in a study by *P. Broms et al, 1982*.

We thus concluded that rhinomanometry is an important tool in decision concerning operation this has also been advocated in past studies, 'Rhinomanometry and septoplasty' by Nicklasson of results by ***Paulo Borges et al in March 2002***.

On rhinomanometric evaluation before operative intervention we found that 22 out of 35 patients had significant or highly significant decrease in airflow due to DNS; the rest of the patients had insignificant air flow decrease (Table - 22), this might be because of the fact that few

of our patients had DNS situated much posteriorly or might be because of inter observer variation or causes related to our self designed apparatus.

On postoperative rhinomanometric evaluation we found that 27 out of 35 patients had significant or highly significant improvement in nasal airflow (Table - 23) When we compared this to the subjective relief we found 23 patients had subjective relief. This might be because of long standing obstruction desensitizes the nose for the sensation of airflow (Table 24). Similar were the findings of a study by ***Jukka Sipila et al. Jan 1995*** (Correlation between subjective sensation of nasal patency and rhinomonometry) As far as the over all satisfaction to some patient was concerned most of our patients were satisfied to some extent after surgery even if few had on improvement in the airflow, this might be because of the fact that there was improvement in other symptoms e.g. headache, sinusitis, SOM, CSOM etc. (Table - 9)

In this study 35 patients were subjected to surgery. Surprisingly, the associated sinus pathology occurs as frequently and severely on narrow nasal cavity as it does in the opposite side While the narrowing of nasal cavity on one side seems to be critical factor in the pathogenesis of ipsilateral sinusitis, concurrent middle turbinate and lateral wall abnormalities, that are possibly compensatory to the septal deviation, are the key factors in the pathogenesis of contralateral sinusitis (Table - 15)

This observation of ours was reinforced by the fact we found inferior turbinate hypertrophy, concha bullosa, enlarged bulla in many of our cases having chronic rhino sinusitis.

Inappropriate selection of surgery as a therapeutic option and inaapropriate choice of surgical modality do seem to be a major cause of dissatisfaction. Misconceptions regarding, which anatomic conditions actually do and do not benefit from septoplasty may factor into blame. Surgeons may fail to recognize that, in some cases, the septal deformities are unrelated to the parent's complaints and, therefore, such cases are inappropriately choosen for septal surgery as a treatment modality. On the other hand, an incomplete assessment of the patient's condition may result in the decision to perform septoplasty as a lone procedure, which constitutes an insufficient management of the diverse pathology present. Conspicuous septal deformities often lead the surgeon to conclude that any further evaluation of the patients is unnecessary. Hence, a septal correction without appropriate management of concurrent sinus disease may well be an important source of dissatisfaction in these patients. The anatomy of nasal cavity is complicated. Septal deformities are found at various locations. Our study supports the view that rhinomanometery is an important supplement to rhinoscopy and questioning of the patients ***(Broms, Johnson and Malm, 1980)***. In this study a good correlatoion

was found between the findings at clinical examination and the rhinomanometric results, and a fair correlation between the patients complaints about nasal obstruction and the results of rhinomanometery. It is important to discriminate between those patients who were satisfied with the operation regarding nasal obstruction and those had other expectations.

Our study has shown that the critical resistive area in the nasal cavity is the anterior part of nose. Precisely speaking in a properly decongested nose this area corresponds to the region near the caudal end of upper lateral cartilage. Thus we conclude that the even small septal deviation in this area can cause significant nasal obstruction ***(Obstructive nasal valve' by Samy Elwany in 1995 Dec.)***. Further more the mucosal component of resistance, which is attributed to erectile tissue in the anterior part of septum and the inferior turbinate, is of particular importance in the anterior part of nose, where in health, half of the total airway resistance of respiratory passage is located. This is confirmed by the studies which by acoustic rhinometery ***L.F. Grymer et al Nov 1989*** found out that the minimum crossectional area is located in the anterior part of nose at 2-3 cm from the nostril. Thus our study found that, as we only subjected the patient septoplasty many patient with minor septal deviation anteriorly but a high value of airflow resistance as found out by

active anterior rhinomenometery were dissatisfied as far as complain of nasal obstruction. Such patients are better candidates for septorhinoplasty rather than septoplasty alone, as in septorhinoplasty takes care of the integrity of nasal valve *(Mark B et al Dec 1995)*. Here we would like to mention that one of our patients with minor anterior deviation had infranuclear facial palsy of same side. This patient after septoplasty had no improvement in airflow after septoplasty because he had a deformed nasal valve and probably was a candidate for septorhinoplasty.

Thus to conclude, in association with usual orthodox methods of nasal examination rhinomanometry seem to be of much more practical importance in understanding nasal airflow and selecting patients for operative intervention than previously through.

Results & Conclusions

RESULTS AND CONCLUSION

- Nasal obstruction and associated nasal pathology because of DNS constitute a major portion of the patients visiting out department.
- Most of the patients with DNS were males; this was attributed to social factors rather than any other aetiopathological factor.
- When classified on the basis of position, anterior DNS was more common than the posterior; and posteriorly only spur was found. Along with DNS compensatory lateral wall pathology e.g. ITH, concha bullosa, osteomeatal complex diseases etc. was also commonly found.
- Rhinomanometric analysis showed significant decrease in airflow because of DNS that too in the patients having anterior deviations.
- Postoperative rhinomanometric analysis showed that there was significant improvement in air flow that had anterior DNS, but few patients didn't improve because they also had associated nasal valve deformity.
- Good correlation was found between rhinomanometric results and improvement in subjective airflow sensation in those patients who had anterior DNS without concomitant nasal valve pathology.

- Anterior DNS causing more nasal obstruction and nasal discharge followed by headache and PND.
- Posterior DNS by pressing on the lateral wall structures caused other effects e.g. headache, vertigo, mastoid pain, PND, tinnitus.
- While selecting patients for septoplasty we found that it was important to select patient who ha only obstructive complaint, as other patients with lateral wall or sinus pathology needed other interventions too.
- Attention must be given to nasal valve region as many patient need septorhinoplasty rather than septoplasty alone.
- Rhinomanometry in association with clinical evaluation is an important tool in proper selection of patients for surgery.

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